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Closer look into Australian maritime heroism at Gallipoli

New heat stress monitoring tool

Advanced traffic management skills for autonomous vehicles

Cover versus concealment

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The Defence Science and Technology Organisation (DSTO) is part of the Department of Defence and provides scientific advice and support to the Australian Defence Organisation. DSTO is headed by the Chief Defence Scientist, Dr Roger Lough, and employs about 2200 staff, including some 1300 researchers and engineers. It is one of the two largest research and development organisations in Australia.

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New monitoring tool takes heat off **deployed personnel**

DSTO researcher Peter Sanders with the Environmental Strain Index device.

Australian Defence Force (ADF) personnel working in hot environments must manage their body temperatures in order to avoid the debilitating effects of heat-induced illness. To do this, they require information on the severity of the heat load imposed by the environment in which they are working.

Until recently, the only means available to the ADF to determine heat loadings was a technique developed in the 1950s known as the Wet Bulb Globe Temperature (WBGT) index.

This involved taking readings from a WBGT apparatus, and then by referring to a table, factoring in details of types of clothing worn, physical activity undertaken and the timings of work and rest periods.

Using such an approach, it was possible to determine how a task may be carried out while minimising the risk of heat illness.

The issue of practicality

However, obtaining WBGT index readings involved the use of three thermometers – shaded dry bulb, black globe and wet bulb, usually attached to a single electronic recording device – with a weighted average calculated from them.

As DSTO researcher Peter Sanders explains, "The apparatus for obtaining such readings was bulky and fragile."

"Furthermore, it needed to be mounted on a fixed base, and it required maintenance at least daily, all of which precluded its ready use *in situ* with the personnel whose welfare was reliant on it."

"Since operations generally take place some distance from the base location where WBGT instruments are sited, the heat loadings at the operational site could well differ significantly," he says.

DSTO's portable index tool

DSTO has undertaken to overcome this problem by devising an instrument that provides all the functionality of the WBGT apparatus in portable form.

This instrument reports an Environmental Strain Index (ESI) figure that is closely correlated to that of the WBGT, derived from measurements of temperature, humidity and solar radiation.

The new instrument, now in its late stages of development, will be the size of a large mobile phone with the design qualities of being robust, waterproof and almost maintenance-free. It will be easy to use, reporting an ESI reading at the press of its single control button.

Team leaders working at remote locations will use this data in association with the table of factors to manage the risk of heat illness.

The Occupational Health, Safety and Compensation Branch of the Department of Defence provided funding for the development of the device.

Closer look into Australian maritime heroism **at Gallipoli**

DSTO is participating in a marine archaeology project that aims to throw more light on the extraordinary saga of Australia's first submarine combat operation.

AE2 *at sea in 1915*
(Photo courtesy of Australian War Memorial).


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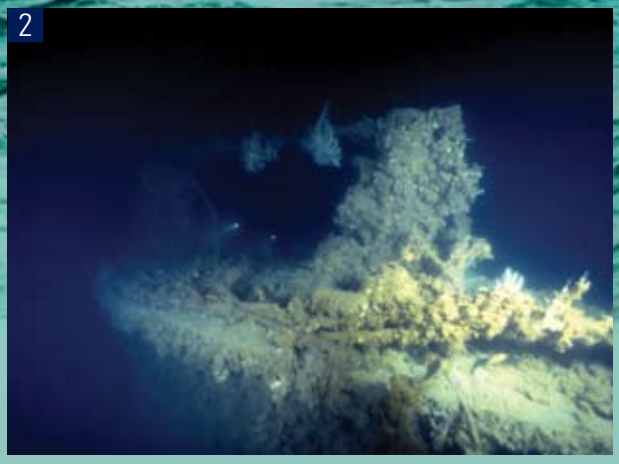
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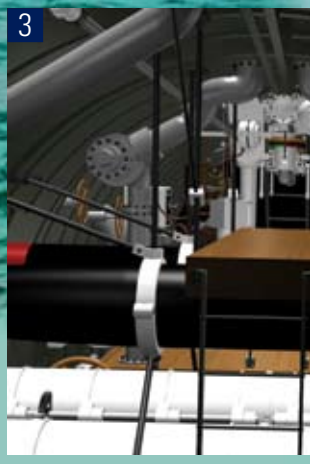
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On 25 April, the Australian E-type submarine *AE2* was ordered to the Straits of the Dardanelles to disrupt and attack enemy shipping.

Although it managed to torpedo a Turkish vessel, the boat had little further success, and five days later, it sank in the Sea of Marmara. The crew abandoned the boat and were imprisoned by the Turks.

For the next 83 years, *AE2* remained out of sight and basically out of mind until Turkish marine archaeologist Selçuk Kolay located the wreck of a submarine in the Sea of Marmara. Australian counterparts Tim Smith and Mark Spencer were invited by Turkish authorities to establish whether it was in fact *AE2*, which they did after diving on the wreck in 1999.

The *AE2* archaeological project

A group of enthusiastic Australians has since taken up the cause to conserve *AE2* as an important national relic, managed by the not-for-profit *AE2* Commemorative Foundation.

One area of work necessary to determine how best to do so is that of ascertaining the condition of *AE2's* internal structures. Given that it would not be possible for divers to safely carry out this work, DSTO's Dr Roger Neill was approached to make an assessment of the chances of successfully using robotic survey devices to make the assessment.

Dr Neill and several of his colleagues agreed to undertake this assessment, working in their own time. As a preliminary step, the team decided to create a 3-D computer model of the *AE2* interior to see if a small remotely operated vehicle could negotiate the maze of pathways involved.

The model was devised using copies of the original plans for *AE2* plus photos of other E-Class submarines from various sources, including the original builders, Vickers Shipyards, the Royal Australian Navy Archives, the Australian National Archives, the British Submarine Museum and the private collections of Tim Smith and Mark Spencer.

"This has proven to be a very challenging task because there are significant inconsistencies between the various plans and photographs," says Dr Neill. "In several instances we have had to pretend to be the submarine builder deciding how best to arrange piping and machinery. After three years of

1. DSTO researchers with remotely operated vehicle to be used in AE2 *survey.*
2. AE2 *at her resting place at the bottom of the Sea of Marmara. (Photo courtesy of MarkSpencer.com.au)*
3, 4, 5. 3-D models of AE2 *produced by the DSTO team.*

A short-lived but strategically effective mission

The story of HMAS AE2*'s mission begins on the first day of the Gallipoli landing when she set off into the Dardanelle Straits with orders to 'wreak havoc' on Turkish shipping in the Sea of Marmara. For the next five days and nights, Captain Henry Stoker and his crew of 31 braved treacherous unknown mine-infested waters when submerged, and fire from the formidable Turkish shore batteries and naval vessels while surfaced.*

AE2 *earned the distinction of becoming the first Allied submarine to reach the Sea of Marmara. In the course of her journey through the Narrows, she seriously disabled a Turkish cruiser with a torpedo attack, and this also resulted in the withdrawal of a battleship that had been shelling the Anzac landings on the far side of the Gallipoli peninsula. Because of inherent defects in early torpedo design, and various misadventures experienced when carrying out torpedo attacks, the boat failed to otherwise inflict any damage.*

Although AE2 *made little impact in terms of sinkings, the alarm caused by her mere presence is thought to have significantly assisted the Gallipoli campaign by disrupting enemy supply lines to the invasion zone. Some analysts consider that without* AE2*'s contribution, British and Anzac forces may well have been quickly driven back into the sea, with a far more disastrous outcome ensuing than that from the foothold occupation attained.*

AE2 *met her demise when she experienced control difficulties that caused her to involuntarily surface right into the line of fire of a Turkish torpedo boat. After sustaining several hits, Captain Stoker gave the order to scuttle the vessel before surrendering. The boat slowly sank to its watery grave on a flat seabed in 73 metres of water. The crew were rescued, and most of them survived the rest of the war in internment.*

4

5

work we have produced a model that we believe will realistically represent the layout of the submarine."

During the course of this project, it was decided that it may also be useful to have access to a high-fidelity model of the outside of the submarine, so the team set about making computer-based models which were recently completed, showing the boat rigged in various operational trims.

Virtual survey for a real-life exercise

The finished 3-D models of the boat have enabled the team to conduct virtual fly-throughs and fly-arounds of *AE2* to confirm that a remotely operated vehicle (ROV) could usefully assist a survey team in undertaking a marine archaeological assessment of *AE2*.

A more detailed and comprehensive archaeological investigation of *AE2* will be carried out in September this year in what will be another joint Turkish-Australian expedition mounted to investigate the wreck. The venture, being driven by the Submarine Institute of Australia, has attracted support from the Australian Government.

DSTO has agreed to assist the investigation by providing a specialist team to work on site with the ROV.

"This vehicle will undertake a number of tasks," says Dr Neill. "In addition to its photographic and sonar survey duties, it will use specialist instrumentation to measure the thickness of the submarine's hull at a number of structurally critical locations."

A practice run with the ROV and full team members was carried out in February this year on a scuttled RAN J-class submarine in the waters off Port Phillip Heads at a depth of 34 metres.

A number of options are being considered for future management of *AE2*. These include leaving the boat on the seafloor as it is, taking steps to protect it from trawler and shipping activity and slowing the rate of corrosion; and recovering it for display on land in a wet or dry environment. A decision about the eventual fate of *AE2* will be made jointly by the Australian and Turkish governments.

Cover versus concealment – **the crucial difference**




DSTO is conducting trials on the ability of various kinds of cover available to infantry in combat situations (such as the walls of buildings) to provide protection against fire. The results dramatically show that some solid forms of shelter may not be as benign or as enduring as many soldiers might think, with important lessons offered both for the use of shelter and for attacks being made on it.

Above and across page: high-speed video images of ricochet bullet strike on gelatine torso.

Trial member marking impact point during witness screen trial.

Trial personnel setting up photography equipment.

The request for the work came from the Australian Defence Force (ADF) Combat Training Centre (CTC), which had found that ADF personnel were often unable to use their weapons to full effect against enemy forces positioned in various kinds of shelter, and conversely, make best use of such kinds of shelter themselves.

Many personnel were not sure of the difference between 'concealment' in which they were hidden from view but not necessarily protected from fire, and 'cover' in which they were both concealed and protected.

In December last year, DSTO researchers conducted the first of two trials to investigate these aspects of combat at the Proof and Experimental Establishment at Port Wakefield, South Australia. The trial team also included personnel from the Army 3rd/9th Light Horse as well the Royal Melbourne Institute of Technology and Vision Research. The role of Trial Director was jointly undertaken by DSTO's Carmine Cauputo and Matthew Smith.

Carmine Caputo says, "The small arms weaponry and the kinds of shelter used in the study were generally typical of those in the close-quarters urban engagement scenarios that ADF forces may encounter during service in the Middle East and East Timor."

A mix of weaponry and trial targets

The weaponry selected for the trials included the AK47 assault rifle (7.62x39 mm round) commonly used by armed forces and militias in many countries overseas, and the Mag58 general purpose machine gun (7.62x51 mm round) and Austeyr assault rifle (5.56x45 mm round) used by the ADF.

The type of shelter being tested in this first trial consisted of single cavity brick wall, constructed of 4 kg red-clay bricks with a 70 millimetre cavity.

Eight of these walls were constructed for the trial, painted yellow so that bullet impact marks would clearly show up as black streaks or exposed red brick.

A series of 15 to 30 rounds were fired at these walls from a distance of 50 metres, aimed at angles from 5°, 15°, 30°, 45°, 60°, 75° and 90°. The trial process as well as outcomes were recorded on digital stills and video cameras.

The photography setup for the trial was a major logistical undertaking, involving high-speed cameras with very large telephoto lenses, and the use of mirrors to provide views in the line of fire without exposing equipment to possible damage. The photography gear overall had to be sheltered from the elements, and that placed in front of the firing position had to be protected against flying fragments as well.

Part of the trial preparations involved constructing a 'soft' rifle mount for remote firing of the AK47. A meteorological station was also set up to provide data about surface wind direction and speed.

Studying the lethality of the ricochet effect

One part of the trial examined the lethality of the ricochet effect, involving a series of firings at the five selected angles from 5° to 60° onto a brick wall, with the ricocheting bullets impacting black-painted panels known as 'witness screens' set up at right angles to the wall.

Some witness panels consisted of a single sheet of one-millimetre thick aluminium, while others were composite packs. The degree of damage caused by the ricochets to these screens gave a measure of the likely severity of injuries that personnel would have sustained.

Cover versus concealment – the crucial difference: continued

Trial personnel placing gelatine torso in position.

Trial crew monitoring a trial from inside blockhouse.

Some impacts left neat holes, while others, caused by rounds tumbling on their long axis, created long tears called keyholes. Some caused multiple impact points after the round fragmented on impact with the wall.

The ricochet effect was also studied using a gelatine torso placed at the edge of the wall to catch the projectile fragments at a 15° impact angle, exposed to rounds from the Austeyr and AK47 weapons.

The two torsos presented for testing were made of a 20% strength solution of gelatine jelly, which, at a temperature of 12°C, is known to have a consistency like that of human tissue, making it usable for studies of the severity of damage sustained by a human body when subjected to impacts of various kinds.

Optimising torso performance

Presenting the torsos for trial involved a high degree of coordination between the various teams involved in the firing exercises in order to ensure that they were at the correct temperature – neither too cool nor too warm – when firing was carried out.

Before the trial, the torsos were kept in refrigerated storage at 10°C in plastic wrap to maintain their consistency at close to the required temperature. After placement on the firing range with the wrap removed, their temperature was monitored with a removable thermometer to determine when they had attained the requisite 12°C through warming from ambient heat.

To assist with photo recording of the trial, the torsos were illuminated by a light from below, causing the translucent yellow gelatine mass to glow internally, while another spotlight was trained on the side to further boost luminosity. The purpose of applying these lights during the trial in what was already strong summer daylight was to raise light levels adequately for the capture of high-speed video footage shooting at up to 7,500 frames a second.

At these speeds of video capture, the journey of the bullet, travelling at approximately 900 metres per second, could be clearly seen as it ricocheted from the wall and impacted the torso.

Two high-speed cameras were used as a pair, positioned 3 metres apart and 50 metres from the target, to provide a stereoscopic view of the trials. By combining matching frames from both cameras, researchers have been able to generate three-dimensional images of the bullet strikes on a torso to gain a measure of the depth of penetration caused by each projectile type.

Penetrative power put to the test

Trials were also carried out to test the penetrative effect of rounds on shelters. The rounds were fired from a distance of 50 metres at 75° and 90° to the target materials.

Results of these tests showed that a seemingly impenetrable solid object, such as a double brick wall, will only provide temporary shelter against today's high-powered infantry weapons.

Single-shot fire, with its pin-point precision accuracy, was shown to be far more effective in this regard than automatic fire where shots spray across a much greater area.

Trial outcome resources

Carmine Caputo says, "Looking at the photographic materials we obtained, the trial was clearly a huge success. It was made possible by the photographic technologies that enabled the capture of trial results at a distance."

The photographic resources generated will be used to create an educational package for CTC staff to enhance their judgment when adjudicating training engagements. Video images and stills will be provided for trainees to demonstrate the real effects of small arms fire on various forms of shelter.

The photos are also being used for research on the performance of small arms weapons and their impact on various kinds of targets.

A second trial planned for later this year will carry out further studies on the effects of small arms on a range of other materials including reinforced concrete slabs, steel plates, sandbag walls, weatherboard, plasterboard, corrugated iron, earth mounds, timber, dense foliage, rocks and rubble and body armour.

Getting priorities right for military communications

During times of high network stress for military communications, congestion can limit the ability of mission-critical information to get through. DSTO has devised a system known as the Military Bandwidth Broker (M-BB) to ensure that preferential treatment is given to more important information flows.

Defence communication systems, like those in the commercial world, are increasingly making use of multimedia communications.

A large part of the Defence communications infrastructure will soon carry bulk multimedia traffic, involving elements of voice, video and data, using Internet Protocol (IP) technology, all with differing degrees of military importance.

This expansion in traffic will place increasingly higher demands on system capacity and its management.

The capacity of a system to transmit digital data – known as bandwidth – is often limited by system components that constrict data flows in the course of data processing and delivery.

Defence communications bottlenecks

Two such components in the Defence system, satellite links and High Grade Crytographic Equipment, are considered to be points where congestion can occur, leading to extensive information dropouts or increased delay for information delivery.

According to DSTO researcher Dr Marek Kwiatkowski, "This IP environment currently offers only best effort service. In other words, if congestion arises, mission-critical and non-mission-critical flows suffer the same high level of information dropouts or increased delay in delivering information."

DSTO researchers Mr Peter George (sitting) and Dr Marek Kwiatkowski with the M-BB software.

"For these reasons, we see that it is crucial for the Defence bandwidth-constrained IP environment to provide the mission-critical traffic with preferential treatment, not only in bandwidth-impoverished parts of this environment, such as satellite links, but as broadly as possible."

Amelioration measures

To overcome this problem, DSTO has mounted a research effort over the last couple of years to devise a bandwidth brokerage concept adapted to military requirements.

Dr Kwiatkowski says, "Unlike commercial networks, which usually prioritise particular user applications or traffic types, our multi-domain bandwidth brokerage provides automated flow admission control and dynamic prioritisation according to a Defence enterprise operation policy, and it also incorporates input from end-users indicating how important the flow is."

"In addition, M-BB can impose limitations in duration and demand for high priority. Altogether, this preferential treatment is called Military-oriented Quality of Service (M-QoS). Information of high military importance can obtain a guaranteed bandwidth, and therefore be quickly delivered through congested networks, while the delivery of less important information, such as logistics, is delayed," he says.

The bandwidth brokerage application supports graceful degradation in Quality of Service for pre-empted data flows, meaning that the system continues to provide bandwidth to these flows but at a lower than agreed level. However, graceful degradation is not provided to voice calls, since this could impact their intelligibility.

M-BB proofing and commercial development

In the late stages of the project, DSTO built an experimental software platform in order to verify the M-BB concept.

This verification process was carried out at DSTO, and also during a multinational trial with the US Air Force Research Laboratory and Communications Research Centre, Canada. The latter work was undertaken as a collaboration between the three organisations within The Technical Cooperation Program (TTCP) on coalition network management.

DSTO has since transitioned the M-BB research results to private sector company Tenix Defence under a licensing agreement.

Both organisations participated from 2004 until 2006 in a Defence Capability Technology Demonstrator (CTD) program, culminating in the construction and successful demonstration of a near-production M-BB.

Tenix Defence is making use of feedback supplied by Defence during the CTD to design a simplified end-user graphic user interface in preparation for a Defence trial.

Advanced traffic management skills for **autonomous vehicles**

DSTO has participated in two research projects recently to give unmanned aerial vehicles (UAV) the capability of avoiding collisions in flight with their own kind, and to help unmanned ground vehicles (UGV) autonomously establish the best way to traverse difficult terrain. Both ventures have resulted in ground-breaking outcomes.

Situational awareness displays of six actual UAVs in flight during collision avoidance trial at Woomera.

In 2004, DSTO entered into a collaboration with the Singaporean Defence Science Organisation (DSO) to develop and test the ability of an onboard collision avoidance system (OCAS) aimed at keeping multiple airborne UAVs safely apart.

This two-year program was conducted under DSTO's Automation of the Battlespace Initiative and the Australia-Singapore agreement on Multi-UAV Collision Avoidance.

The impetus for research arose from concerns that the airspace in future operational arenas could well become very crowded with UAVs.

The trial phase of the research was carried out late last year at the Woomera Test Range where twelve UAVs - six actual and six virtual - were flown on a collision course.

The virtual UAVs used in the trial were generated by DSTO with its Force Level Electronic Warfare Simulation Environment (FLEWSE), while the actual UAVs were provided by Melbourne-based company, Aerosonde.

Other private-sector companies providing support included Swordfish Computing and Consunet.

Setting a collision course

Giving background to the conduct of the exercise, DSTO researcher Andrew Bailey says, "The likelihood of collision was set to be intentionally high. The trial was designed to establish how well the UAVs could identify the risk of impact, share this information, and modify their flight paths to avoid impact."

The process of attaining a collision course for the UAVs to avert, however, was not at all straightforward. Local weather conditions, with high temperatures that gave rise to strong thermals and variable wind patterns, made it difficult to accurately synchronise a single impact point for the actual UAVs used in the trial.

"The solution," explains Bailey, "was to adjust the speed of the UAVs with our ground control stations to ensure the craft would reach the impact point all at the same time."

Once the UAVs were on target, the ground controllers directed the UAVs to independently engage their OCAS to avoid collision, which they all readily managed.

The successful outcome of this trial, involving as it did twelve UAVs, is thought to be a world-first.

While some of the OCAS functions for the test were performed by ground-based equipment, research is under way to build these functions into the UAV craft so that in future they will be carried out entirely on board.

UAV provides pathfinding eyes for UGV

Another recent trial under DSTO's Automation of the Battle Space Initiative was undertaken to study improvements in UGV performance made possible by integrating UAV and UGV operations.

The trial, involving the University of Sydney, the University of Adelaide and the Australian Defence Force Academy, was conducted at the University of Sydney's Marulan test site in New South Wales.

A small helicopter UAV, carrying a miniaturised payload of electro-optic and laser radar sensors, flew over the terrain to produce a series of three-dimensional (3-D) strip images, which were fused into a single 3-D map of the area. These were then downloaded into the UGV to assist with its autonomous route planning processes.

The UGV, also equipped with navigation sensors including laser radar, Global Positioning System, Inertial Navigation System and electro-optic cameras, was capable of developing a 3-D view of its surrounds from a ground perspective.

Using the laser-generated maps from the UAV, the UGV was able to autonomously plan and then navigate its route through a bush setting. The 3-D aerial maps allowed the UGV to avoid obstacles such as trees, bushes and steep or uneven sections of terrain.

An impressively smart system

At the commencement of the trial, the UGV was instructed to travel between two points at extreme ends of the test site, separated by some thick scrub and rough terrain.

The on-board computers of the UGV then calculated the best route to take, with the unit remaining stationary throughout this process. When it started its journey, the course it embarked on came as a surprise to all present.

DSTO researcher Jean-Pierre Gibard recalls that "the UGV turned 180 degrees and headed for the dirt road through the test site which, though longer, was logically the best route."

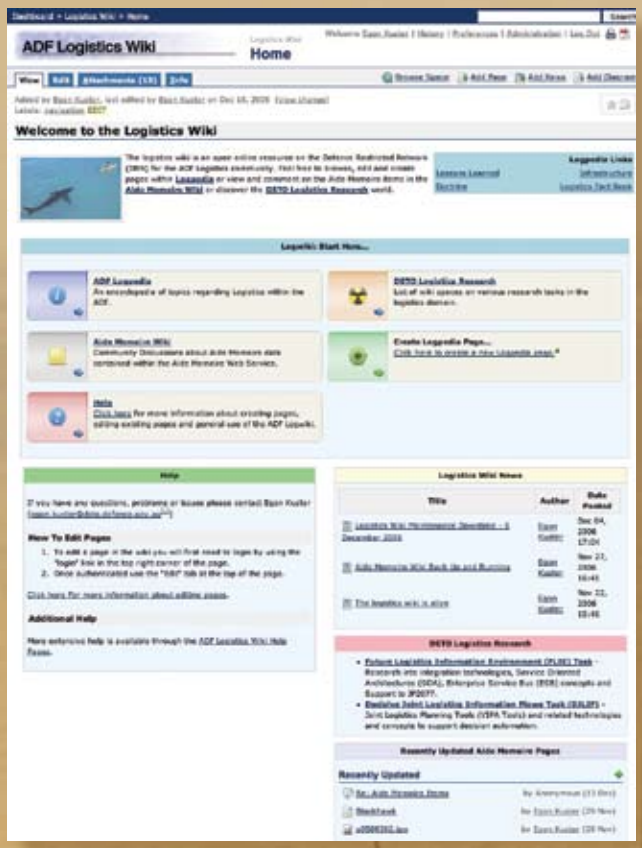
The trial established that the aerial mapping data from the UAV significantly improved the robustness and efficiency of UGV route planning and navigation processes. The 3-D UAV maps were especially useful for identifying sloping terrain and low-lying obstacles that could not be detected by the UGV's sensors.

The success of this trial, hailed as an Australian first, is seen to be a significant advance in DSTO's overall quest to develop a capability for unmanned vehicles and other robots to carry out dangerous tasks for the Australian Defence Force in place of personnel.

Above photos: UAV and UGV in use during trials at Marulan test site.

Wiki knowledge network tool **for Defence**

DSTO has developed an online resource, known as Logwiki, which provides a new way for Defence personnel to acquire, share and develop knowledge related to logistics.



Logwiki web site home page.

DSTO researcher Egon Kuster with Logwiki web site.

Part of a web page on Blackhawk helicopters on the Logwiki site.

The Logwiki approach to knowledge development is similar to that of Wikipedia, a free online encyclopaedia now avidly used by millions of people around the world on a daily basis, operating in many different languages.

The knowledge base of a Wikipedia-style resource, called a 'wiki' (*Hawaiian, meaning 'quick'*), is entered and validated by the community of users themselves.

While the veracity of such resources has been deeply questioned by some commentators, a study reported in the journal, *Nature*, has found Wikipedia to have a reliability similar to that of Encyclopaedia Britannica, with comparable error rates for established articles on both major and minor errors and omissions.

Logwiki site concept

DSTO researcher Egon Kuster explains, "The innovation that Wikipedia brings to the field of knowledge generation and management is that instead of panels of experts working 'behind closed doors' for the creation and editing of articles, the entire community – experts and novices alike – are involved in an open work process."

"Because wikis, such as Wikipedia and Logwiki, are easy to use and encourage contributions, the number of articles contained in these knowledge resources is vastly greater than traditional resources, creating a more comprehensive and informative knowledge base."

The basic ground rules for contributing information are that content must be referenced. Changes made to Logwiki articles are recorded in an Information page, so that all entries made are preserved, and everyone can see the entire development history of an article.

"This history also assists the process of undoing incorrect changes, and everyone is encouraged to get involved and have a go," says Kuster.

A corollary of the wiki approach is that any concerns over article content are openly discussed and are fully traceable, allowing a reader to better judge the quality of information in a wiki article than for those in an encyclopaedia.

Articles are interlinked with others using familiar web hyperlinks, and so, the Logwiki website as a whole constitutes a seamless, interactive knowledge base.

Unlike traditional information repositories that develop their knowledge resources periodically with the release of new issues, a Wikipedia-style knowledge base is in a state of constant evolution, continually improving on the overall accuracy of the information provided, and also expanding and adapting the information available in response to changes in the real world.

In the context of ADF operations, this aspect of Logwiki means the resource can be used to provide up-to-date content for Standard Operating Procedures and even Doctrine.

Built-in dispute resolution

By making the process open to a large number of contributors, the number of errors that might arise when relying on a single source is reduced. Any perceived aberrations are given attention by a potentially large pool of editors who work to achieve an agreed view.

If there are issues that simple agreement is unable to resolve, levels of regulation may be employed, ranging from informal mediation to formal mediation and finally arbitration by a committee.

The expectation of the Logwiki developers is that regulatory volunteers will emerge as people develop an understanding of the value of the Logwiki.

The Wikipedia experience has shown that this approach to dispute resolution works. At the same time, experience has shown that only a handful of the tens of thousands of new articles created every month have ever required the attentions of an arbitration committee.

Logwiki success established

A prototype version of Logwiki has been made available to all Defence personnel on the Defence Restricted Network (DRN). Those visiting for the first time are encouraged to participate with online help pages that provide information on how to access the site as well as write and edit articles. There is no style or content manual at present.

According to ADF member, Capt Michael Cullen, Army, who recently familiarised himself with Logwiki, resources of this kind represent a significant advance over previous ways of doing business.

"There is a growing interest worldwide and within the ADO on the importance of knowledge management," he says. "The growth of wikis on the internet is exploding. I believe that the use of wikis and similar software will eventually be adopted by Defence, as has happened already with mobile phones, email, internet usage, databases, video conferencing and web pages.

"Wikis will allow us to capture much of the dispersed knowledge that is currently stored in email boxes, personal drive spaces and within the heads of unit members. Having this knowledge in an easily-updatable, easily-searched system will provide quick access to important data and assist unit officers and NCOs in making more informed decisions in a shorter time. It will greatly assist our productivity, reduce wasted effort and retain hard-earned experience."

Lt Col Bob Strachan, Acting Director of Strategic Logistic Planning & Analysis, Strategic Logistics Branch, also enthuses about the potential usefulness of this knowledge resource, saying that, "Logwiki provides a flexible and easy-to-use way for ADF logisticians to increase the value of data by enhancing 'hard facts' with qualifying or background information. Such information might, for example, include an individual's experience of operating or maintaining a particular ADF platform under special or unusual conditions."

ADF personnel with DRN access can visit the Logwiki site at http://logwiki.dsto.defence.gov.au.

Putting a face to an invisible enemy

DSTO has developed software tools that model the behaviour of invisible chemical, biological, radiological (CBR) agents under various environmental conditions in order to enhance Australian Defence Force capabilities for countering these threats.

One of the biggest problems faced by CBR countermeasure researchers and response team personnel is that CBR agents are not only invisible; some of them are also odourless, and they can be very difficult to detect even with sophisticated sensors.

To complicate matters further, the spread and lethality of CBR agents are closely determined by the influence of local atmospheric conditions, physical structures and terrains.

This presents a special problem for the conduct of military experimentation, civilian counter-terrorism exercises and operational planning, because the precise location and level of the threat can be hard to visualise, and the impact difficult to estimate.

A calculated response to CBR threats

In recent years, a team of scientists from DSTO and its equivalent organisations in USA, UK, Canada and NZ have been developing novel solutions to the problem of identifying how plumes of CBR agents disperse under a range of weather conditions and environments.

The work involves a range of mathematical procedures, such as solving highly complex equations, implementing fast numerical solutions, and inverse modelling for source tracing and identification.

In addition to this work, DSTO scientists have gained expertise in the use of a CBR modelling and simulation tool, the Hazard Prediction and Assessment Capability (HPAC), developed by the US Defense Threat Reduction Agency.

Having developed this expertise, DSTO has been given responsibility for providing training support to the State and Federal government emergency management and response agencies, as well as the Special Operations Command's Incident Response Regiment.

Adding jSWAT to the countermeasure modelling tool set

A further advance in DSTO's capabilities with CBR modelling and simulation has been to interface HPAC with the Joint Seminar Wargame Adjudication Tool (jSWAT), a wargaming software tool developed by DSTO in support of the Army Experimentation Framework.

The HPAC-jSWAT tool set provides a scientifically rigorous estimation and visualisation of CBR threats in an operational environment. It enables

DSTO researchers with CBR modelling and simulation tool.

wargame players and operational planners to experiment with different CBR detection tactics, protection procedures, and deployment and manoeuvre response options in hostile operational scenarios.

This new capability has been developed by DSTO in close consultation with sponsors and stakeholders.

The first phase of this development was completed mid-last year, with additional CBR modelling, simulation and visualisation functionalities being introduced into jSWAT as part of the jSWAT Project development more recently.

Like DSTO's work on modelling CBR plume dispersal, the advantages offered by the HPAC-jSWAT tool set are also being applied in civilian counter-terrorism training exercises and operational planning.

JDSSC facility to be established

A new facility, known as the Joint Decision Support & Simulation Centre (JDSSC), will be set up in a new Defence laboratory at Fairbairn close to the former RAAF base in Canberra.

The JDSSC is being developed as a partnership between the Australian Defence Force's Capability Development Executive (CDE) and DSTO.

It will form part of DSTO's Next Generation Battle Labs for its Network Centric Warfare and Joint Experimentation program mounted under the DSTO Experimentation Initiative, connected in a network also with other simulation and experimentation centres operated by Defence, Australian industry and overseas partners.

The JDSSC will assist Canberra-based strategy and capability development decision-makers by providing information on complex Defence strategy and capability issues.

The Centre will consist of a team of analysts using a range of analytical and simulation tools and experimentation techniques to provide scientific assessment of new strategic and operational doctrine.

Five-year Research and Development Alliance for DSTO and BAE Systems

The Parliamentary Secretary to the Minster for Defence, Mr Peter Lindsay, recently announced the formation of a five-year agreement between DSTO and BAE Systems, building on previous working arrangements that have been in place over the last twelve years.

"The extension and upgrade of this alliance arrangement will ensure that the high quality of science DSTO produces is augmented by the full benefit of some of the best private sector scientific and technological minds in Australia," Mr Lindsay said.

"This Strategic R&D Alliance means that interaction between the two organisations will happen at the CEO and strategic planning levels, rather than the lower levels of the previous agreement."

The two organisations will collaborate on projects in the areas of electronic warfare, autonomous systems, high-frequency surveillance, air defence, air platforms, mission simulation and training, and intelligence surveillance and reconnaissance mission support.

Collaborative projects of note undertaken previously include the Nulka Active Missile Decoy Program, fatigue testing for the Hawk Lead-in-Fighter and the Advanced Short Range Air-to-Air Missile.

During the signing of the agreement (L-R): Lincoln Wood (BAE Systems), Jim McDowell (CEO, BAE Systems), Parliamentary Secretary for Defence Peter Lindsay, Chief Defence Scientist Roger Lough, and Deputy Chief Defence Scientist Neil Bryans.

New situational awareness capability for ADF platforms

DSTO has developed a capability for in-service Australian Defence Force (ADF) ships and aircraft to share situational awareness data using a software program called Rosetta.

Previously, personnel on such craft could only share information with others by reviewing the situational awareness picture available to them, and communicating their findings verbally.

The Rosetta technology, created by US defence industry company ANZUS, enables the automatic transfer of data between platforms, thereby allowing each platform to contribute to the creation of a larger and more detailed situational awareness picture available to all. The information that can be shared includes real-time imagery and sensor data.

DSTO's development process involved the use of simulators and test beds, applying (in laboratory conditions) the communications equipment fitted to ANZAC Frigates, Seahawk helicopters and AP-3C Orions.

The development represents a further step along the way towards full network centric warfare integration of military platforms, allowing for a significant shift away from reliance on traditional voice-based methods of information sharing. The new technology will also enable ADF assets to share information over greater distances.

CALENDAR

2 Aug 2007	Defence Watch Briefing National Press Club,Canberra http://www.c3i.com.au
15 - 26 Aug 2007	Australian Science Festival Canberra http://www.sciencefestival.com.au/
20 - 22 Aug 2007	Signal and Image Processing 2007 Honolulu, Hawaii United States of America http://www.iasted.com/conferences/home-576.html
21 -24 Aug 2007	Defence and Industry Conference Convention Centre, Adelaide http://www.defenceandindustry.gov.au
24 - 26 Sep 2007	Communication, Network and Information Security 2007 UC Berkeley, Berkeley, California United States of America http://www.iasted.com/conferences/home-589.html
25 - 26 Sep 2007	SETE 2007 (Systems Engineering Test and Evaluation) Conference Sydney http://www.sesa.org.au/
8 - 10 Oct 2007	Modelling and Simulation 2007 Beijing, China http://www.iasted.com/conferences/home-571.html
22 - 26 Oct 2007	Land Warfare Conference Convention Centre, Adelaide Tel: 08 8259 6719 Email: vinod.puri@dsto.defence.gov.au
19 - 21 Nov 2007	Intelligent Systems and Control 2007 Cambridge, Massachusetts United States of America http://www.iasted.com/conferences/home-592.html
20 - 22 Nov 2007	MilCIS 2007 National Convention Centre, Canberra http://www.milcis.com.au/
13 - 15 Feb 2008	Signal Processing, Pattern Recognition and Applications Innsbruck, Austria http://www.iasted.com/conferences/home-599.html

ADS15/2-006/2007 Cover image: The bow of RAN submarine *HMAS AE2* at the bottom of the Sea of Marmara off Turkey, (Photo courtesy of MarkSpencer.com.au)